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| 10/718,192 | 11/20/2003 | Yian-Liang Kuo | TS03-336 | 9795 |

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|---|---|
| CHU, CHRIS C | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2815 | |

DATE MAILED: 09/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H' B

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/718,192 | KUO ET AL. | |
| | Examiner | Art Unit | |
| | Chris C. Chu | 2815 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *22 June 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *25 - 29, 31 - 37, 41 - 45, 47 - 53 and 57 - 62* is/are pending in the application.

4a) Of the above claim(s) *57 - 62* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *25 - 29, 31 - 37, 41 - 45 and 47 - 53* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 June 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Response to Amendment*

1. Applicant's amendment filed on June 22, 2005 has been received and entered in the case.

### *Drawings*

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description:

(A) In Fig. 3A and 3B, the reference numbers "200" and "202" are not referenced in the specification of instant invention.

Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### *Specification*

3. The disclosure is objected to because of the following informalities:

(A) On page 5, Fig. 3A and Fig. 3B are not disclosed in the Brief Description of the Drawings.

(B) Fig. 3A and Fig. 3B are not disclosed in the Detailed Description of the Preferred Embodiment

Appropriate correction is required.

### *Claim Objections*

4. Claims 31 and 47 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claims, or amend the claims to place the claims in proper dependent form.

### *Claim Rejections - 35 USC § 112*

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 25 and 41 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one

skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

(A) In claims 25 and 41, there is no support for the thermal grease comprising silicon rubber that contains heat-conducting particles, epoxy resin, curing agent, a catalyst, a coupling agent, a filler, a flame retardant, a mold-release agents, a coloring agent and a stress-relief agent.

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 25, 29 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Khatri (U. S. Pat. No. 6,610,635), and further in view of Uchida et al. (U. S. Pat. No. 5,346,743).

Regarding claims 25, 29 and 31, Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- a heat spreader (29) mounted over the ball grid substrate and spaced apart from the molding compound to form a gap; and

- thermal grease (27) within the gap at least between the heat spreader and the molding compound .

While Juskey et al. teaches the use of the thermal grease, Juskey et al. does not appear to provide any example of the thermal grease's specific composition (i.e., silicon rubber containing zinc oxide; claim 29). Khatri teaches in column 2, lines 11 – 17 the thermal grease may be composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of Juskey et al. as taught by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

Furthermore, While Juskey et al. and Khatri teach the use of the thermal grease (i.e., silicon rubber containing zinc oxide), Juskey et al. and Khatri do not appear to provide the thermal grease comprising epoxy resin, curing agent, a catalyst, a coupling agent (claim 31), a filler, a flame retardant, a mold-release agents, a coloring agent and a stress-relief agent. Uchida et al. teaches in Table 3 in columns 17 and 18 a thermal resin being composed of epoxy resin, curing agent, a catalyst, a coupling agent, a filler, a flame retardant, a mold-release agents, a coloring agent and a stress-relief agent. It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the thermal resin of Uchida et al. with the thermal grease of Juskey et al. and Khatri as taught by Uchida et al. to reduce the package cracking and excellent in reliability in terms of humidity resistance (column 2, lines 39 – 45).

9. Claims 26, 27, 34 and 35 – 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 26 and 27, Juskey et al. and Khatri disclose in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al. and Khatri do not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (64) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the silicon as the specific material to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Long et al. to provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

Regarding claim 34, Since Juskey et al., Khatri and Long et al. disclose silicon semiconductor chip that has 2 to 3 * $10^{-6}$/°K of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al., Khatri and Long et al. disclose the

limitation "the semiconductor chip has a coefficient of thermal expansion of from "about" 2.5 to 3.5 * $10^{-6}$/°K.

Regarding claims 35 – 37, while Juskey et al. and Khatri disclose in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 37), Juskey et al. and Khatri do not appear to provide another example of the heat spreader's specific shape to be an inverted square pie tin that has an elongated surrounding lip that is attached with epoxy onto the substrate (claims 35 - 37). Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the "L" shape of the element 88 on the element 44B; column 7, lines 60 - 62) that is attached with epoxy (44b; column 3, lines 1 – 3) onto a substrate (48). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader that is attached with epoxy onto the substrate in the structure of Juskey et al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

10. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and further in view of Culnane et al. (U. S. Pat. No. 5,785,799).

While Juskey et al. and Khatri disclose in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al. and Khatri do not appear to provide any

example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Culnane et al. to improve the thermal efficiency for removing heat form a chip to increase reliability and potentially increase power dissipation to allow a higher device density (column 2, lines 41 – 44).

11. Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and furthermore in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 32 and 33, Since Juskey et al., Khatri and Culnane et al. disclose the use of a copper heat spreader that has $17 * 10^{-6}/°K$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation "the heat spreader has a coefficient of thermal expansion of about 17.0". However, Juskey et al., Khatri and Culnane et al. do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific range of the coefficient of thermal expansion including 10 to $60 * 10^{-6}/°K$. Note that "about" 7.0 includes $10 * 10^{-6}/°K$ about the same based in the metes and bounds of "about" disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to $60 * 10^{-6}/°K$ as the specific range of the coefficient of thermal expansion for the

epoxy molding compound in the structure of Juskey et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

12. Claims 41, 45 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Khatri, further in view of Uchida et al., and even further in view of Lee et al. (U. S. Pat. No. 6,362,530).

Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- thermal grease (27) over the molding compound; and
- a heat spreader (29) mounted over the ball grid substrate (10), the molding compound (20) and the thermal grease (27).

While Juskey et al. teaches the use of the thermal grease, Juskey et al. does not appear to provide any example of the thermal grease's specific composition (i.e., silicon rubber containing zinc oxide; claim 45). Khatri teaches in column 2, lines 11 – 17 the thermal grease may be composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of Juskey et al. as taught

by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

Furthermore, While Juskey et al. and Khatri teach the use of the thermal grease (i.e., silicon rubber containing zinc oxide), Juskey et al. and Khatri do not appear to provide the thermal grease comprising epoxy resin, curing agent, a catalyst, a coupling agent (claim 47), a filler, a flame retardant, a mold-release agents, a coloring agent and a stress-relief agent. Uchida et al. teaches in Table 3 in columns 17 and 18 a thermal resin being composed of epoxy resin, curing agent, a catalyst, a coupling agent, a filler, a flame retardant, a mold-release agents, a coloring agent and a stress-relief agent. It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the thermal resin of Uchida et al. with the thermal grease of Juskey et al. and Khatri as taught by Uchida et al. to reduce the package cracking and excellent in reliability in terms of humidity resistance (column 2, lines 39 – 45).

Finally, Juskey et al., Khatri and Uchida et al. do not disclose a PCB substrate mounted to the heat spreader. Lee et al. teaches in e.g., Fig. 2D a PCB substrate (240) mounted to a heat spreader (224). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the PCB substrate onto the heat spreader in the structure of Juskey et al., Khatri and Uchida et al. as taught by Lee et al. to allow the heat spreader to be directly attached to a heat dissipating pad of the printed circuit board to dissipate heat away from die through the printed circuit board (column 7, lines 52 – 57).

13. Claims 42, 43, 50 and 51 – 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri, Uchida et al. and Lee et al. as applied to claim 41 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 42 and 43, Juskey et al., Khatri, Uchida et al. and Lee et al. disclose in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al., Khatri, Uchida et al. and Lee et al. do not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (79) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the silicon as the specific material to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al., Khatri, Uchida et al. and Lee et al. as taught by Long et al. to (1) provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

Regarding claim 50, Since Juskey et al., Khatri, Uchida et al. and Long et al. disclose silicon semiconductor chip that has 2 to 3 * $10^{-6}$/°K of the coefficient of

thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al., Khatri, Uchida et al. and Long et al. disclose the limitation "the semiconductor chip has a coefficient of thermal expansion of from "about" 2.5 to 3.5 $10^{-6}$/°K.

Regarding claims 51 – 53, while Juskey et al., Khatri, Uchida et al. and Lee et al. disclose in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 53), Juskey et al., Khatri, Uchida et al. and Lee et al. do not appear to provide another example of the heat spreader's specific shape to be an inverted square pie tin that has an elongated surrounding lip (claims 51 – 53) that is attached with epoxy onto the substrate. Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the "L" shape of the element 88 on the element 44B; column 7, lines 60 - 62) that is attached with epoxy (44b; column 3, lines 1 – 3) onto a substrate (48). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader that is attached with epoxy onto the substrate in the structure of Juskey et al., Khatri, Uchida et al. and Lee et al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

14. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri, Uchida et al. and Lee et al. as applied to claim 41 above, and further in view of Culnane et al. (U. S. Pat. No. 5,785,799).

While Juskey et al., Khatri, Uchida et al. and Lee et al. disclose in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al., Khatri, Uchida et al. and Lee et al. do not appear to provide any example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader in the structure of Juskey et al., Khatri, Uchida et al. and Lee et al. as taught by Culnane et al. increase reliability and potentially increase power dissipation to allow a higher device density (column 2, lines 41 – 44).

15. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri, Uchida et al. and Lee et al. as applied to claim 41 above, and further in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 48 and 49, Since Juskey et al., Khatri, Uchida et al. and Culnane et al. disclose the use of a copper heat spreader that has $17 * 10^{-6}/°K$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation "the heat spreader has a coefficient of thermal expansion of about 17.0". However, Juskey et al., Khatri, Uchida et al. and Lee et al. do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific range of the coefficient of thermal expansion

including 10 to 60 * $10^{-6}$/°K. Note that "about" 7.0 includes 10 * $10^{-6}$/°K about the same based in the metes and bounds of "about" disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to 60 * $10^{-6}$/°K as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of Juskey et al., Khatri, Uchida et al. and Lee et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

***Response to Arguments***

16. Applicant's arguments with respect to claims 25 and 41 have been considered but are moot in view of the new grounds of rejection.

***Conclusion***

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 10:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For

more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu
Examiner
Art Unit 2815

c.c.
Wednesday, August 31, 2005

Tom Thomas

TOM THOMAS
SUPERVISORY PATENT EXAMINER